ON A RELATION BETWEEN THE SPECTRUM OF TURBULENCE AND THE SPECTRUM OF NOISE IT RADIATES

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The generation of sound by turbulence is represented by the Lighthill (1952) tensor, of which the main term is the Reynolds stresses. Thus the acoustic pressure depends on the two-point turbulent velocity correlation and the acoustic power on its four-point correlation. The space-time Fourier transform the latter is the four-point turbulence spectrum. The acoustic power spectrum of sound generated by turbulence, is calculated in terms of the four-point turbulence spectrum in general, and then simplified for incompressible, isotropic turbulence. The method of evaluation of acoustic radiation integrals involving multi-point turbulence spectra is demonstrated first by calculating the acoustic pressure from two-point turbulence spectra, and then applied to the calculation of acoustic power spectra from four-point turbulence spectra. The present results allow a prediction of the power spectrum of noise emitted by turbulence, using as input only the turbulence spectra. This is a distinct approach from the Corcos (1963) type schemes which use semi-empirical functions. On a relation between the spectrum of turbulence and the spectrum of noise it radiates.